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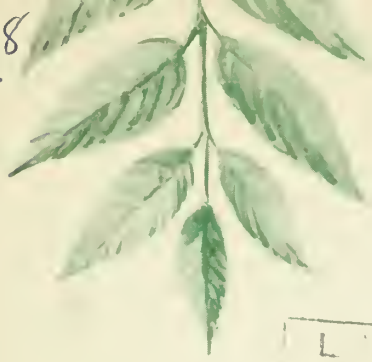

SILVICAL CHARACTERISTICS *of* BLACK WALNUT

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Central States Forest Experiment Station
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Miscellaneous Release 22

This is the eighth of a series of 17 papers dealing with the silvical characteristics of forest trees important in the Central States region. The following species are included in this series. (Those marked with an asterisk have already been published.)

*Ohio buckeye
Yellow buckeye
*Northern red oak
*Black oak
Chinkapin oak
*Pin oak
*White oak
Swamp white oak
Bur oak
Butternut
*Black walnut
*Shellbark hickory
Sycamore
Honeylocust
Hackberry
Black locust
*Eastern redcedar

Papers covering additional important American species will be issued by other Forest Experiment Stations of the U. S. Forest Service.

Central States Forest Experiment Station, U. S. Dept. of Agriculture
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W. G. McGinnies, Director

December 1957

Silvical Characteristics of Black Walnut

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Black walnut is one of the best known and most valuable of American forest trees. It grows throughout most of the eastern half of the United States (20)[1/]. Throughout most of this range, walnut grows large enough to be merchantable, but the greatest commercial production is centered in the states of Missouri, Ohio, and Indiana (4). The wood is highly prized for fine furniture and gunstocks, and the nuts are an important food product.

1/ Numbers in parentheses refer to Literature Cited, p. 12.

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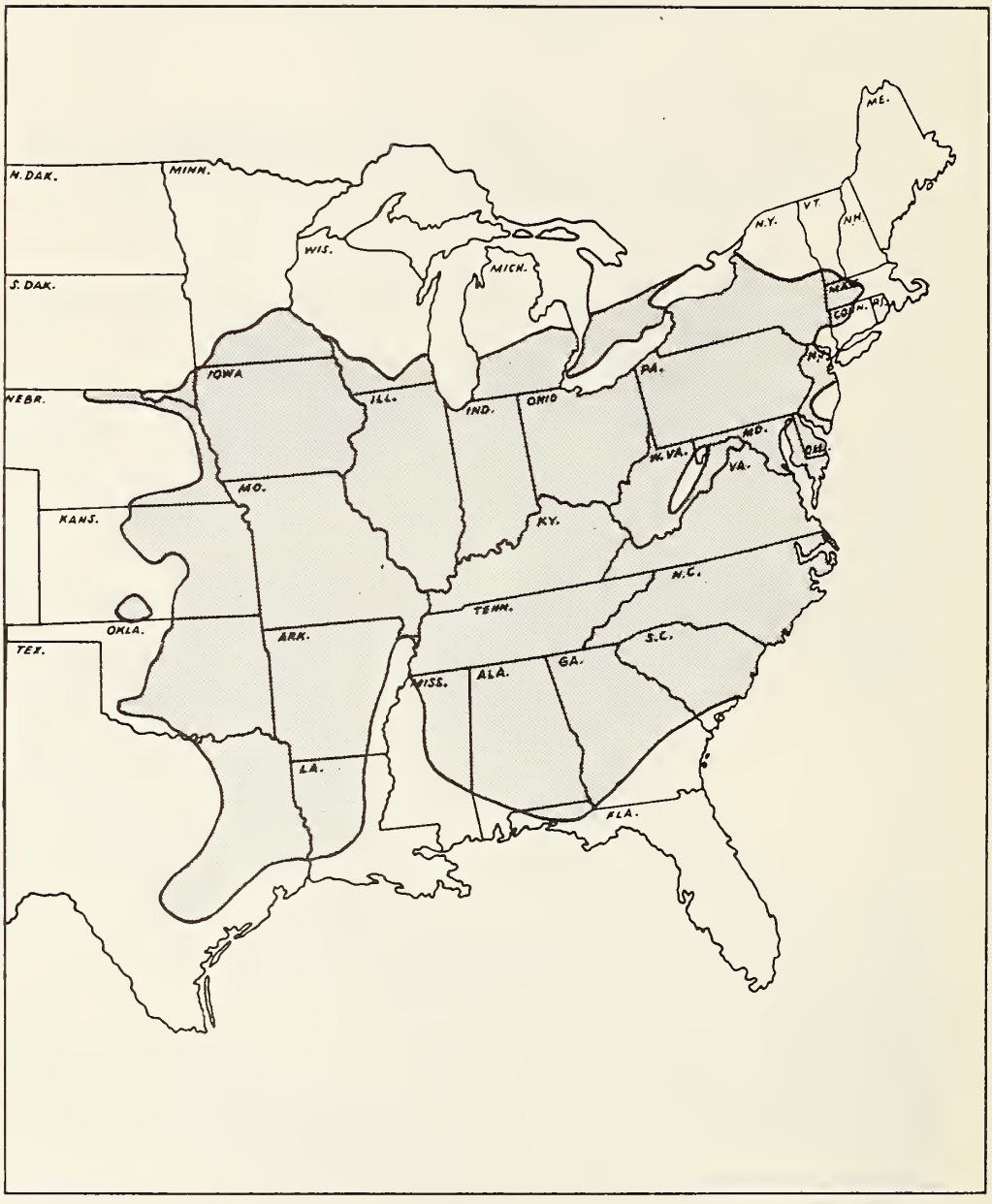

SITE

Climate

Black walnut grows in a variety of climates, with frost-free seasons ranging from 140 days in the north to 280 days in western Florida (28). Annual precipitation within its range varies from less than 25 inches in northern Nebraska to 70 inches or more in the Appalachians of Tennessee and North Carolina. Mean annual temperatures vary from about 45 degrees in the north to 67 degrees in the south. Temperatures as low as -45 degrees have occurred where walnut grows, but all races of the species will not survive such cold. Within the optimum range for walnut, the average annual temperature is about 55 degrees, with a frost-free season of at least 170 days, and an average annual precipitation of at least 35 inches.

Soils

This species is very sensitive to soil conditions, requiring a deep, well-drained, nearly neutral soil with a generous supply of moisture and nutrient material for best growth (1, 2). On wet bottomlands, or on sandy, dry ridges and slopes, it grows much slower than on good sites. Walnut is common on limestone soils and does especially well on deep loams, loess soils, and fertile alluvial deposits. Good agricultural soils generally are favorable sites for walnut.

Physiography

In the Appalachians, the best walnut is found on bottomlands and in coves below 4,000 feet elevation (2). Throughout its wide range, it reaches greatest size and value on moist, fertile sites, generally along streams and at the base of north- or east-facing slopes. This is particularly true near the limits of its distribution. Trees growing on the uplands or on other unsuitable sites are not as desirable for lumber or veneer because of slower growth rates and poorer quality.

Associated Species

Walnut occurs in many of the mixed mesophytic forests, but is never abundant (5). The species generally is found as scattered trees, rarely in pure stands of limited extent on the edge of

the hardwood forest (4). The chief associates include yellow-poplar, white ash, black cherry, basswood, beech, sugar maple, oaks, and hickories (27). The eastern redcedar-hardwood type of Kentucky and central Tennessee often contains a high percentage of walnut (14). Near the western limits of its range, walnut may be confined to the floodplains where it occurs either with American elm, hackberry, green ash, and boxelder, or with basswood and red oak on lower slopes and other very favorable sites (32).

The large, distinctively flavored nuts furnish food for red squirrels in the fall, eastern gray squirrels in fall and winter, and make up as much as 10 percent of the diet of eastern fox squirrels (21). The nuts also are eaten by the red-bellied woodpecker (7). Many nuts buried by squirrels are not recovered, so that the animals are important in establishing additional trees, particularly on the fringes of existing stands. Van Dersal (31) reports that walnuts also are eaten by the white-tailed deer

No universal indicator of a good black walnut site is known. Baker (3) suggests that the Kentucky coffeetree is a trustworthy guide, but this species itself is relatively rare. In general, where yellow-poplar or white ash grow well, black walnut should also thrive.

Walnut seldom grows well in pure stands. Most plantations have been disappointing because of poor growth rate or quality. This may be partly because of off-site planting or overstocking, but livestock grazing also has contributed to plantation failure especially in the Midwest (16).

There seems to be an antagonism between walnut and many other plants which excludes some species from the root zone of walnuts. This has been attributed to a toxic substance, possibly juglone, which is present in the roots. Actual contact with the walnut roots apparently is necessary before the associated plants are harmed (6, 25). Most tree species appear to be immune, yet walnut seedlings do not persist under or adjacent to established trees. In many cases, this condition cannot be explained satisfactorily by competition for light and moisture. It is quite probable that walnut seedlings also are affected by the toxic substance, but this has not been proved.

LIFE HISTORY

Seeding Habits

Depending somewhat on latitude, the flowers generally appear from April 10 to June (18). The staminate catkins are located on the previous year's growth, while the pistillate flowers are in groups of 2 to 5 at the ends of the current growth (11). The large fruit ripens in September or October of the same year, dropping shortly after the leaves fall (30).

Abundant seed crops are produced irregularly, perhaps twice in 5 years. Although open-grown trees may produce some seed as soon as 8 years after planting, the minimum seed-bearing age for commercial quantities of seed is about 12 years (24, 30). Best production begins when the trees are about 30 years old and continues for another 100 years.

Vegetative Reproduction

After small trees are cut or killed back by fire, the stumps usually sprout freely. Sprouts originating high on older stumps may develop heart rot or other decay from the parent stump, but sprouts from the root collar generally are free from this defect.

More than 100 named varieties of walnut have been selected through the years, mostly for characteristics of large, easily extracted nut meats (12). About 15 of these varieties were found to have outstanding qualities when tested by the TVA (35). Propagation of selected strains is by grafting or budding (26).

Seedling Development

Nearly all natural seedlings originate from nuts buried by squirrels in the fall. The preferred storage spots appear to be the places where walnut seedlings have the best chance to survive natural openings in the forest or grassy areas on the forest fringe. Normal freezing and thawing usually will cause the seeds to break dormancy the following spring, but germination is often delayed.

Figure 1.--Forty-year-old black walnut plantation in Indiana.

Because of the sustained demand for walnut for lumber and veneer, this species has been widely planted throughout much of its natural range. The usual practice is to plant either the nuts themselves in the fall or 1-year-old seedlings in the spring. Older trees are much more difficult to transplant because of their size and large root systems.

Direct seeding in the fall usually gives better results than when done in the spring (23). Unless other food is available, however, squirrels may seek out and consume many of these nuts during the winter. Where this is expected to be a problem, the nuts may be stratified over winter in moist sand or peat moss and planted in the spring. Stratified seed generally germinates within 2 months after planting, but even with this treatment, some seed may not germinate for another year.

Regardless of the season or method of planting used, careful choice of planting site is imperative. Good growth cannot be expected where the trees are planted on excessively dry or wet sites, or in infertile soil. The most logical planting places for walnut are along streams, at the base of slopes, or in coves. The trees generally grow best when mixed, either singly or in small groups, with species such as yellow-poplar, white ash, or northern red oak (29). Underplanting of borer-riddled black locust plantations with walnut apparently results in good growth for the walnut (13).

Early height growth of walnut varies a great deal with site. Seedlings emerge in April or May of the first or second spring after planting (8). On deep, rich, moist soils in coves or well-drained bottomlands, young seedlings may grow 3 feet the first year, and double this in the second growing season. Although walnut does not make as rapid height growth as yellow-poplar and white ash on good sites, it generally surpasses the oaks (17). In eastern Nebraska, near the western limits of its range, Holch (15) found that walnut made much better height growth than the oaks and basswood on a prairie site, developing an excellent root system and attaining several times the height of the other species.

Height growth begins rather slowly in the spring, reaches a peak rate in late April and May, and is essentially complete by the middle of July or the first of August. In general, walnut loses its leaves somewhat earlier than its associates, with a growth period of from 115 to 135 days (17).

Sapling Stage to Maturity

On the most suitable sites, young trees may grow 2 or 3 feet a year. Even on less favorable sites, trees may attain heights of 30 to 40 feet and diameters of 5 to 8 inches in 20 years (16). In contrast, walnut planted on Kansas spoil banks made an average diameter growth of only 0.25 inch and height growth of 1.1 feet per year during the first 10 to 12 years (24). On spoil banks, trees grew best on the lower slopes, on areas containing a high percentage of fine soil material, and either under or in mixture with black locust (19).

The tree matures in about 150 years, but may live 250. Wilde (33) reports trees 130 feet tall and 100 inches in diameter in Wisconsin at age 250. Other walnuts have been found that were 150 feet in height and 6 feet in diameter on the most favorable sites (11).

This species is rated "very intolerant" by Harlow and Harrar (14) and intolerant by Baker (3). In mixed forest stands, walnut nearly always is dominant in crown class, with a small, rather open crown.

Open-grown trees tend to be limby. Even in plantations, the light shade of walnut alone is insufficient to bring about early natural pruning. Although 50 to 75 percent of the live crown apparently may be removed without any loss in growth rate, Clark (9) suggested that excessive sprouting of dormant buds may make artificial pruning impractical except in fairly dense stands. Released trees often develop similar new branches along the stem.

Figure 2.--Mature black walnut in Indiana.

Climax Position of Species

Black walnut is represented in many of the "climax" associations, yet because of its intolerance of shade, walnut cannot be called a climax species in the strict sense. Near the western limits of its range, walnut may be part of the elm-ash-hackberry association which succeeds pioneer species such as willows, eastern cottonwood, and boxelder on bottomlands (32). In general, however, walnut maintains itself in most stands only by seeding into openings in the canopy.

ENEMIES AND HAZARDS

This species has few important insect enemies. The most serious is the walnut caterpillar (Datana integerrima) which is distributed over much of eastern United States. Heavily infested trees may suffer some loss in current growth by defoliation, but trees seldom are killed by defoliation alone (10).

Damaged or weakened trees and trees on poor sites are particularly susceptible to European canker, caused by (Nectria galligena) (22). This destructive disease is widely distributed in the northeastern states. Although infected trees eventually die the rate of spread is quite slow. Apparently the disease is less important on exposed sites than in moist locations.

The tree is quite windfirm and not easily damaged by ice or windstorms. The thick bark and naturally durable heartwood make walnut resistant to damage and decay following fires.

RACES AND HYBRIDS

Racial variations of walnut apparently exist, with length of growing season being the greatest variable (34). These differences are very important to know when selecting seed for planting. Individual trees also vary in quality and growth rate, which indicates the importance of selecting seed from superior trees even for local planting.

SPECIAL FEATURES

The wood of black walnut has long been noted for its beauty and ease of manufacture into fine furniture and cabinets. The wood is preferred for gunstocks, where its stability after seasoning, fine machining properties, and uniform texture and strength are nearly ideal. The wood is naturally durable, and has been used for ties and posts (4). Both the stump and forked sections of some trees may be used for sliced veneer.

The nuts of black walnut have a distinctive flavor that is not impaired by cooking. Many rural families supplement their income by collecting and selling nuts to commercial extractors of the meats for use in cookies, candy, and other confections (12).

TREE SPECIES MENTIONED

Green ash	-	*Fraxinus pennsylvanica* Marsh.
White ash	-	*Fraxinus americana* L.
Basswood	-	*Tilia* L.
Beech	-	*Fagus* L.
Boxelder	-	*Acer negundo* L.
Black cherry	-	*Prunus serotina* Ehrh.
Kentucky coffeetree	-	*Gymnocladus dioicus* (L.) K. Koch
Eastern cottonwood	-	*Populus deltoides* Bartr.
Hackberry	-	*Celtis occidentalis* L.
Hickory	-	*Carya* Nutt.
Black locust	-	*Robinia pseudoacacia* L.
Sugar maple	-	*Acer saccharum* Marsh.
Northern red oak	-	*Quercus rubra* L.
Yellow-poplar	-	*Liriodendron tulipifera* L.
Eastern redcedar	-	*Juniperus virginiana* L.
Black walnut	-	*Juglans nigra* L.
Willow	-	*Salix* L.

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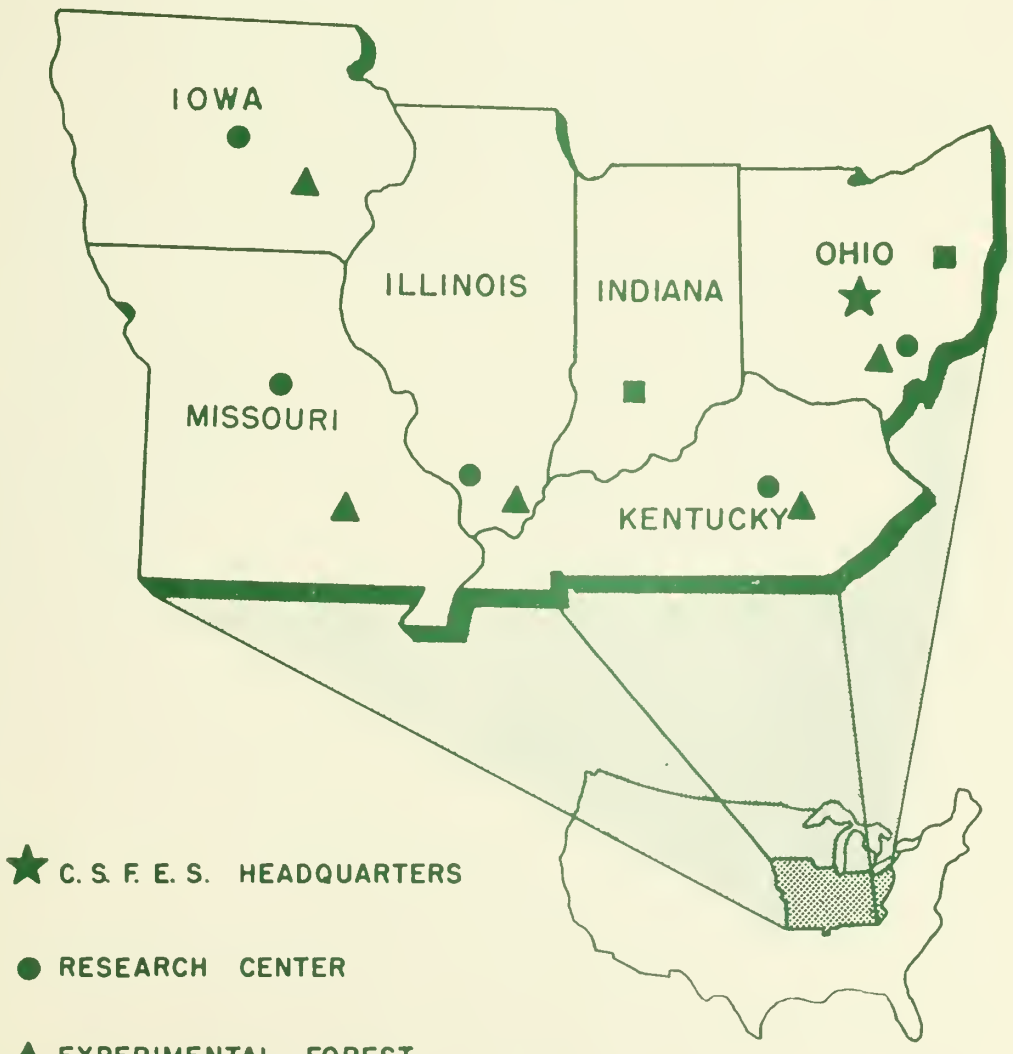
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